Exhibit 1: Central Plant Technology List for COG Modeling Project

Technology List	Gross Capacity (MW)	Data Start Date
Biomass		
Biomass Combustion - Fluidized Bed Boiler	28	Current
Biomass Combustion - Stoker Boiler	38	Current
Biomass Cofiring	20	Current
Biomass Co-Gasification IGCC	30	2018
Geothermal		
Geothermal – Binary	50	Current
Geothermal - Flash	50	Current
Hydropower		
Hydro - Small Scale (developed sites without power)	15	Current
Hydro - Capacity upgrade for developed sites with power	80	Current
Solar		
Solar - Parabolic Trough	250	Current
Solar - Photovoltaic (Single Axis)	25	Current
Wind		
Onshore Wind - Class 5	50	Current
Onshore Wind - Class 3/4	50	Current
Offshore Wind - Class 5	350	2018
Wave		
Ocean Wave	40	2018
Integrated Gasification Combined Cycle		
IGCC without carbon capture - Current commercial scale: single or multiple 300 MW trains	300	Current
Nuclear		
Nuclear: WESTINGHOUSE - AP1000	1100	Current

Biomass

Biomass Combustion - Fluidized Bed Boiler

Circulating fluidized bed (CFB) technology is used for combustion of solid fuels. It was first used due to its ability to handle low quality, high sulphur coals. One of the main advantages of the CFB technology is that it allows the owner to optimize profitability by selecting a wide range of fuels (bituminous coal, bituminous gob or high-ash waste coal, sub-bituminous coal, lignite and brown coal, anthracite culm, coal cleaning tailings and petroleum coke). Other fuels such as wood, shredded tires and sludge are fuel candidates depending on their heat input, moisture content and emissions requirements. This type of boiler provides economy and flexibility.

Biomass Combustion - Stoker Boiler

Stoker boilers have been a standard technology option for biomass as well as coal for many years. A stoker boiler is an excellent combustor of cellulose waste such as wood, garbage, bagasse, industrial residue, peanut shells and shredded tires. Most of these fuels can be burned without auxiliary fuel given proper attention to moisture content.

Biomass Cofiring

One of the most attractive and easily implemented renewable energy sources is derived from cofiring of biomass in existing coal fired boilers. In biomass cofiring, up to 20%-30% of the coal can be displaced by biomass. The biomass and coal are combusted simultaneously. The term “biomass” refers to materials derived from plant matter such as trees, grasses, and agricultural crops. These materials, grown using energy from sunlight, can be renewable energy sources for fueling many of today’s energy needs. The most common types of biomass that are available at potentially attractive prices for energy use are waste wood and wastepaper. Cofiring projects do replace a portion of the nonrenewable fuel—coal—with a renewable fuel—biomass.

When it is used as a supplemental fuel in an existing coal boiler, biomass can provide the following benefits: lower fuel costs, more fuel flexibility, avoidance of landfills and their associated costs, and reductions in sulfur oxide, nitrogen oxide, and greenhouse gas emissions. Other benefits such as decreases in flue gas capacity have also been documented.

Cofiring is a proven technology. Over the past 15+ years, KEMA has gained extensive experience with direct and indirect co-firing of several types of biomass fuels. KEMA has tested co-firing mixtures of coal and several biomass fuels up to about 25% (on an energy basis) in KEMA’s 1 MW test boiler and has been involved in over 50 full-scale commercial and demonstration projects in coal-fired power plants. KEMA is active in the IEA Bio-energy Agreement Task 32 dealing with biomass combustion and co-firing. Within this task the international experience on biomass co-firing is collected and made publicly available.

Biomass Co-Gasification IGCC

Another way of direct replacement of fossil fuel is co-gasification. While co-firing is fully commercially available and adapted worldwide, co-gasification is less common and in a phase between demonstration and commercial application. As a result, the cost models will provide data with a start date of 2018 to reflect that the technology is not yet commercialized but that we believe it will be commercially available in the next 10 years.

Several technical options are available. The simplest one is the realization of a biomass gasifier next to a coal or gas fired power plant. The gas produced by the gasifier is, after cleaning, directly combusted in the boiler. Due to the fact that the thermal conversion of the biomass takes place outside the existing fossil fired unit more polluted or heterogeneous biomass can be used without harming the fossil fired power plant. The typical electric efficiency of this co-gasification approach is somewhat lower than direct co-firing due to a gasifier efficiency of around 80%. Examples are the biomass gasifiers in Lahti (Finland) and Geertruidenberg (Essent, the Netherlands).

The performance of co-gasification can be improved by integrating the biomass gasifier with an IGCC, integrated gasification combined cycle. In this case the gas is combusted in a gas turbine and the gas turbine exhaust gasses are used to drive a steam cycle. The overall electric efficiency is in the range of 40 to 45%. The only co-gasification IGCC example KEMA is aware of is located in Buggenum (Nuon, the Netherlands). An IGCC demonstration project running on 100% biomass was realized in Värnamö (Sweden) in the nineties, this plant is now converted into a plant producing liquid biofuels.

Geothermal

Geothermal – Binary

Recent advances in geothermal technology have made possible the economic production of electricity from geothermal resources lower than 150°C (302°F). Known as binary geothermal plants, the facilities that make this possible reduce geothermal energy's already low emission rate to zero. Binary plants typically use an Organic Rankine Cycle system. The geothermal water (called "geothermal fluid" in the accompanying image) heats another liquid, such as isobutane or other organic fluids such as pentafluoropropane, which boils at a lower temperature than water. The two liquids are kept completely separate through the use of a heat exchanger, which transfers the heat energy from the geothermal water to the working fluid. The secondary fluid expands into gaseous vapor. The force of the expanding vapor, like steam, turns the turbines that power the generators. All of the produced geothermal water is injected back into the reservoir.

Geothermal - Flash

The most common type of power plant to date is a flash power plant, where a mixture of liquid water and steam is produced from the wells. About 45 percent of geothermal electricity production in the U.S. comes from flash technology. At a flash facility, hot liquid water from deep in the earth is under pressure and thus kept from boiling. As this hot water moves from deeper in the earth to shallower levels, it quickly loses pressure, boils and "flashes" to steam. The steam is separated from the liquid in a surface vessel (steam separator) and is used to turn the turbine, and the turbine powers a generator. Flash power plants typically require resource temperatures in the range of 350 to 500°F (177°C to 260°C).

Hydropower

Hydro - Small Scale (developed sites without power)

A "small scale" hydropower facility is defined as having a rated capacity between 1 and 30 MW. There are three categories of small hydropower sites:

- Developed sites without power
- Developed sites with power but with potential to add generation capacity
- Undeveloped sites

This Small Scale Hydropower category focuses on developed sites without power. There are two main types of hydropower facilities:

Impoundment: Utilizes a dam to store river water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity. The water may be released either to meet changing electricity needs or to maintain a constant reservoir level.

Diversion: Utilizes the flow of water within a river, requiring very little or no impoundment (the use of a dam). A diversion hydropower plant is sometimes also called "run-of-river" facility. This type of facility is typically designed for large flows with low head or small flows with high head.

Hydro – Capacity upgrade for developed sites with power

Many existing hydroelectric power plants can be upgraded to increase generating capacity. This can be accomplished through turbine retrofits, changes in flow rates, increasing storage capacity or any combination of the above.

Solar

Solar - Parabolic Trough

The sun's energy is concentrated by parabolically curved, trough-shaped reflectors onto a receiver pipe running along the inside of the curved surface. This energy heats oil flowing through the pipe, and the heat energy is then used to generate electricity in a conventional steam generator.

A collector field comprises many troughs in parallel rows aligned on a north-south axis. This configuration enables the single-axis troughs to track the sun from east to west during the day to ensure that the sun is continuously focused on the receiver pipes. Individual trough systems currently can generate about 80 megawatts of electricity.

Trough designs can incorporate thermal storage—setting aside the heat transfer fluid in its hot phase—allowing for electricity generation several hours into the evening. Currently, all parabolic trough plants are "hybrids," meaning they use fossil fuel to supplement the solar output during periods of low solar radiation. Typically a natural gas-fired heat or a gas steam boiler/reheater is used; troughs also can be integrated with existing coal-fired plants.

Another option under investigation is the approximation of the parabolic troughs by segmented mirrors according to the principle of Fresnel.

Solar - Photovoltaic (Single Axis)

These flat-plate PV arrays can be mounted at a fixed angle facing south, or they can be mounted on a single axis or dual axis tracking device that follows the sun, allowing them to capture more sunlight. For utility-scale electricity generating applications, hundreds of arrays are interconnected to form a single, large system. The arrays produce direct current (DC) which has to be transformed in alternating current (AC) by one ore several inverters.

Wind

Onshore Wind – Class III, IV, & V

Wind power is converted to electricity by a wind turbine. In a typical, modern, large-scale wind turbine, the kinetic energy in the wind (the energy of moving air molecules) is converted to rotational motion by the rotor – typically a three-bladed assembly at the front of the wind turbine. The rotor turns a shaft which transfers the motion into the nacelle (the large housing at the top of a wind turbine tower). Inside the nacelle, the slowly rotating shaft enters a gearbox that greatly increases the rotational shaft speed. The output (high-speed) shaft is connected to a generator that converts the rotational movement into electricity at medium voltage (a few hundred volts).

An alternative is a direct drive wind turbine where the gearbox is avoided and the rotor is directly coupled to a multipole generator. The electricity flows down heavy electric cables inside the tower to a transformer, which increases the voltage of the electric power to the distribution voltage (a few thousand volts). The distribution-voltage power flows through underground lines to a collection point where the power may be combined with other turbines.

Modern utility scale wind turbines have a rated power between 1.5 and 3.0 MW. The rotor diameter then ranges between 60 and 90 m. A typical hub height would be 80-100 m depending on the roughness of the terrain surrounding the wind farm. Even larger wind turbines are in the pilot and demonstration phase. Wind turbines are now developed with a rated power up to 5 MW and a rotor diameter of 125 m. The development to larger wind turbines is mainly driven by offshore wind energy where important cost savings can be established using larger scale wind turbines.

Wind turbines are best combined into wind farms, where the wind turbines are placed closely together. Wind farms can range from 10 to 1000 MW. A typical scale that could be used as a reference is 50 - 100 MW.

Typically wind turbines in high wind speed areas have a larger generator coupled to a relatively small rotor, whilst in low wind speed areas a large rotor drives a smaller generator. These so-called inland wind turbines are often equipped with taller towers. The ratio of power to rotor area (called specific power (W/m2)) is hence an important design parameter. The capacity factor is often used as a measure for the wind turbine output, but this factor can be heavily influenced by the choice of the specific power. Calculating cost generation in terms of capacity factor might therefore be misleading.

The cost of generation is for wind turbines mainly determined by the investment costs of the turbines, the foundation, the electrical infrastructure and the civil installations. Another component is determined by the O&M component. The revenues of a wind turbine are heavily dependent on the wind resource available, and hence the cost of generation. For the revenues the wind resource considered will be class III, IV and V.

Offshore Wind - Class 5

Five countries have wind turbines installed offshore: Denmark, Sweden, the United Kingdom, the Netherlands, and Ireland. Germany has approved 22 projects, with one ready to come online in 2008. No offshore wind projects have been built in the U.S., although a number of projects are moving through the development process. And in May 2008, the U.S. Department of Energy's report on a 20% wind energy scenario found offshore wind capacity could be 54 GW of the 300 GW envisioned.

Until now offshore wind farms have been built in water depths until 20 m deep, at distances less than 20 km to shore. In the coming years it is expected that also wind farms will be built in deeper water at larger distances from the coast.

California has a steep coastline that limits the use of the available technologies. The potential for offshore wind with water depths lower than 20 m is mainly located in Northern California. San Francisco Bay and Southern California have hardly any areas with shallow water. The wind speeds in the shallow areas are in the order of 7.5 m/s, which is far lower than the 10 m/s experienced for offshore wind farms in Europe.

At present the costs of offshore wind energy are not fully understood. Recent years the cost estimates have been increased by 30%. The investment costs depend heavily on the water depth and the distance to shore.

The investment costs for offshore wind energy are at least a factor 2 higher than onshore. The same holds for the O&M costs. With the relatively low wind speeds found in California, it is not expected that offshore wind energy will be a winning technology in the near future. As a result, the cost models will provide data with a start date of 2018 to reflect that the technology is not yet commercialized but that we believe it will be commercially available in the next 10 years.

Wave

<u>Ocean Wave</u>

Wave energy extraction is complex and many device designs have been proposed, but none are currently in commercial use. As a result, the cost models will provide data with a start date of 2018 to reflect that the technology is not yet commercialized but that we believe it will be commercially available in the next 10 years.

For understanding the device technology, it is helpful introduce these in terms of their physical arrangements and energy conversion mechanisms.

- Distance from shore – Wave energy devices may convert wave power at the shoreline, near to the shore (defined as shallow water where the depth is less than one half of the wavelength) or offshore.

- Bottom mounted or floating – Wave energy devices may be either bottom-mounted or floating.

Wave energy devices can be classified by means of the type of displacement and reaction system employed. Various hydraulic or pneumatic power take off systems are used and in some cases the mechanical motion of the displacer is converted directly to electrical power (direct-drive) Four of the most well-known device concepts are introduced below and their principle of operation illustrated.

- Symmetrical point absorber – A bottom mounted or floating structure that absorbs energy. The power take-off system may take a number of forms, depending on the configuration of displacers/reactors. The key characteristic of a point absorber is that it can absorb more energy then available within the devices width if the device is tuned (I.e. its natural resonance frequency matches the incident wave frequency).

- Oscillating Water Column (OWC) – Near-shore or offshore, this is a partially submerged chamber with air trapped above a column of water. As waves enter and exit the chamber, the water column moves up and down and acts like a piston on the air, pushing it back and forth. The air is forced through a turbine/generator to produce electricity.

- Overtopping terminator – A floating reservoir structure with a ramp over which the waves topple and hydro turbines/generators through which the water returns to the sea.

- Attenuator – One form of the attenuator principle is a long floating structure which is orientated parallel to the direction of the waves. The structure is composed of multiple sections which rotate in pitch and yaw relative to each other. That motion is then converted to electricity using an electro-hydraulic power conversion machine.

Integrated Gasification Combined Cycle (IGCC)

IGCC without Carbon Capture

There are several major IGCC process technologies available for power generation. The main suppliers of gasifier technology are Shell, GE, Siemens and ConocoPhillips. There is no need to focus on one of these process technologies in this study, because this will only lead to exclusion of possible viable options for the future. Therefore the selected IGCC technology for this study is based on the current worldwide practice for coal-fueled IGCC technology at a scale of 300 MW. This results in the selection of the oxygen-blown entrained flow gasifier process technology.

The oxygen-blown IGCC process:

Part of the air compressed in the gas turbine is fed to an elevated pressure ASU (air separation unit). The larger part from the air required air in the ASU is supplied by an independent compressor driven by an electric motor. In the ASU the air is split in oxygen and nitrogen. In the gasification island coal (either supplied in slurry or in powder form) is gasified is the reactor into raw gas. Apart from the raw gas also flyash and slag are formed. The raw gas contains:

1. Combustible components CO and H_2
2. Incombustible harmless components H_2O, N_2, Ar
3. Greenhouse gas CO_2
4. traces of environmentally and/or technically harmful gaseous components:
    a. Sulphur: H_2S and COS
    b. Halogens: HCl and HF
    c. Nitrogen: NH_3, HCN
    d. Traces of alkali- and heavy metals (such as mercury)

The raw gas is purified in the gas cleanup (i.e., it is stripped of the sulphur, halogen, nitrous compounds and alkali and heavy metals). During this process waste water and some tail gas is produced. The tail gas is recycled back into the gasification island while the waste water is cleaned in the waste water treatment plant. During this process clean distillate and residue are produced. The distillate is reused in the powerplant.

The cleaned syngas is moisturized to achieve a lower heating value. This contributes to lower NOx emissions. Also the heat rate is improved marginally. To improve the heat rate further the humid syngas is heated with feedwater from the water steam circuit between gasification island and steam cycle. Subsequently the heated syngas is mixed with heated nitrogen from the ASU. This further reduces the NOx emission from the plant.

The diluted syngas is combusted under pressure in the gas turbine used ambient air pressurized by the gas turbine’s compressor. The hot combustion gases drive the gas turbine’s expander providing electric power to drive compressor and generator. The exhaust gases are lead into the steam cycle where steam is produced in the waste heat boiler and is expanded in the steam turbine installation, producing electricity.

Nuclear

WESTINGHOUSE - AP1000

Synonyms: Advanced Passive 1000
Approximate Capacity (electric): 1117-1154 MWe
Reactor Type: Pressurized Water Reactor
NRC Design Certification Status: Certified after December 2005, though amendments have since been proposed.
Supporting Generating Companies (potential site): Duke Power (Cherokee County), Progress Energy (Harris), Southern Company (Vogtle), NuStart Energy-Tennessee Valley Authority (Bellefonte)

The AP1000 design is favored for construction at five to six potential sites (ten to twelve reactors) in the United States. The AP1000 is an enlargement of the AP600, designed to almost double the reactor's target electricity output without proportionately increasing the total cost of building the reactor. Westinghouse anticipates that operating costs should be below the average of reactors now operating in the United States. While Westinghouse owns rights to several other designs, the AP1000 is the principal product that the company now promotes in the United States for near term deployment. The AP1000 includes innovative, passive safety features and a much simplified design intended to reduce the reactor’s material and construction costs while improving operational safety. During 2007 or 2008 it is anticipated that the AP1000 will be the subject of combined license (COL) applications to build and operate new reactors in the United States. In early 2005 Westinghouse submitted a bid to build a version of the AP1000 to build as many as four AP1000s at two sites in China.

Westinghouse Corporation was selected to supply new nuclear plants in China and other countries. Its design of the AP-1000 system has been accepted on the world basis. China’s plan to purchase 100 AP-1000 plants over the next 25 years is an indication of an international acceptance of this design. Furthermore, the AP1000 has been identified as the technology of choice for no less than 12 new projected plants in the United States.